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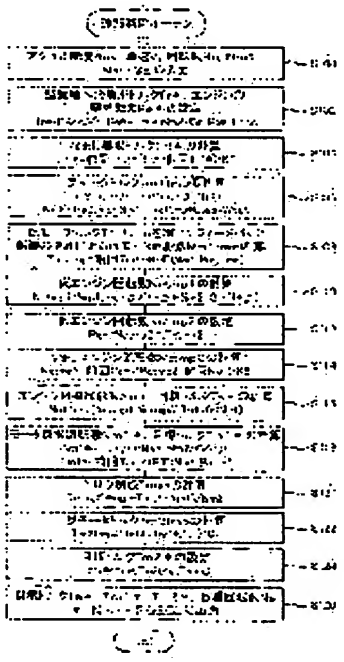
(54) HYBRID VEHICLE AND ITS CONTROLLING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To output a driving power requested when an accelerator is turned off after it is turned on smoothly to a drive shaft while taking account of the discharge limit of a battery and to alter the r.p.m. of an engine smoothly.
SOLUTION: A temporary engine r.p.m. Netmp1 is calculated as the r.p.m. for satisfying both the limit for smoothly altering a driving power requested when an accelerator is turned off after it is turned on and the discharge limit Wout of a battery (S110), a dull engine r.p.m. Tetmp3 is calculated as the r.p.m. for altering the r.p.m. of an engine smoothly (S114), the lower r.p.m. is set as the target r.p.m. of the engine Ne* (S116), and the engine and two motors are controlled (S126). For the driver's operation of turning the accelerator from on to off, a corresponding torque can be outputted smoothly to the output shaft within the discharge limit of the battery and, at the same time, engine r.p.m. can be altered smoothly.



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CLAIMS

[Claim(s)]
[Claim 1]
It is the hybrid car in which an output of power is possible to the driving shaft connected to the driving wheel,
With an internal combustion engine
A power power I/O means to transmit a part of power [at least] from said internal combustion engine to said driving shaft with I/O of power and power,
The motor which can output and input power to said driving shaft,
Said power power I/O means, and said motor and the accumulation-of-electricity means which can exchange power,
the accelerator after accelerator-on was carried out -- an operation point setting means to set up the operation point of said internal combustion engine for outputting the driving force according to the driving force this demanded based on the this demanded driving force and a discharge limit of said accumulation-of-electricity means when the driving force depended off is required of said driving shaft,
The control means which controls this internal combustion engine, said power power I/O means, and said motor so that the driving force corresponding to said demanded driving force is outputted to said driving shaft, while said internal combustion engine is operated on the set-up this operation point
******** hybrid car.
[Claim 2]
Said operation point setting means is a hybrid car according to claim 1 which is a means to set up the 1st rotational frequency calculated as said internal combustion engine's rotational frequency from the driving force obtained by processing by annealing to said demanded driving force, and a discharge limit of said accumulation-of-electricity means as a target rotational frequency in said internal combustion engine's operation point.
[Claim 3]
Said operation point setting means is a hybrid car according to claim 2 which is a means to set up a small rotational frequency as a target rotational frequency in said internal combustion engine's operation point among the 2nd rotational frequency obtained by processing by annealing to said internal combustion engine's rotational frequency calculated from said demanded driving force, and said 1st rotational frequency.
[Claim 4]
The relation to which said operation point setting means becomes equal to the driving force with which the sum of the 1st driving force transmitted to said driving shaft based on the power outputted and inputted from said power power I/O means and the 2nd driving force which are outputted and inputted by this driving shaft from said motor processes by annealing to said demanded driving force, and is obtained, With said power power I/O means Said 1st rotational frequency by which the sum of the 1st power outputted and inputted and the 2nd power which are outputted and inputted by said motor is calculated based on said 1st driving force called for from the relation it is equal to a discharge limit of said accumulation-of-electricity means

unrelated as a target rotational frequency in said operation point The hybrid car according to claim 2 or 3 which is a means to set up.
[Claim 5]
Said operation point setting means As opposed to the relational expression of the target power which should be outputted and inputted from this power power I/O means at the time of carrying out feedback control of said power power I/O means using the this set-up target rotational frequency when said internal combustion engine's target rotational frequency is set up The hybrid car according to claim 4 which is a means to calculate said target engine speed obtained by inverse operation, using the power outputted and inputted from said power power I/O means calculated from said 1st driving force as said target power as said 1st engine speed.
[Claim 6]
Said control means carries out drive control of said power power I/O means on the drive conditions set up in order to operate said internal combustion engine on said set-up operation point. So that the driving force corresponding to difference with the driving force obtained by processing by annealing to the driving force which acts on said driving shaft by this drive control, and the driving force by said demanded accelerator-off may be outputted to this driving shaft There is no claim 2 which is the means which carries out drive control of said motor, and it is the hybrid car of a publication 5 either.
[Claim 7]
Said control means is a hybrid car according to claim 6 which is the means which carries out drive control of said motor within the limits of a discharge limit of said accumulation-of-electricity means.
[Claim 8]
There is no claim 1 equipped with a 3 shaft type power I/O means to output and input power on a residual shaft based on the power which connected with 3 of the output shaft, said driving shaft, and 3rd shaft of said internal combustion engine shafts, and was outputted and inputted on any 2 shafts of these three shafts, and the generator which output and input power on said 3rd shaft, and said power power I/O means is the hybrid car of a publication 7 either.
[Claim 9]
the 1st rotator by which said power power I/O means was attached in said internal combustion engine's output shaft, and the 2nd rotator attached in said driving shaft -- having -- the electromagnetism of this 1st rotator and this 2nd rotator -- claim 1 which is the pair-of-observations trochanter motor which outputs a part of power [at least] from this internal combustion engine to this driving shaft with I/O of the power by operation thru/or 7 -- either -- the hybrid car of a publication.
[Claim 10]
It is the control approach of a hybrid car equipped with an internal combustion engine, a power power I/O means to transmit a part of power [at least] from this internal combustion engine to the driving shaft connected to the driving wheel with I/O of power and power, the motor that can output and input power to this driving shaft, and this power power I/O means, and this motor and the accumulation-of-electricity means which can exchange power,
(a) the accelerator after accelerator-on was carried out -- the operation point of said internal combustion engine for outputting the driving force according to the driving force this demanded based on the this demanded driving force and a discharge limit of said accumulation-of-electricity means, when the driving force depended off is required of said driving shaft -- setting up
(b) While said internal combustion engine is operated on the set-up this operation point, control this internal combustion engine, said power power I/O means, and said motor so that the driving force corresponding to said demanded driving force is outputted to said driving shaft.
The control approach of a hybrid car.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the hybrid car in which an output of power is possible to the driving shaft connected to the driving wheel, and its control approach in detail about a hybrid car and its control approach.
[0002]
[Description of the Prior Art]
The epicyclic gear device in which the ring wheel was connected to the driving shaft mechanically connected with the axle while the carrier was conventionally connected to the crankshaft of an engine and this engine as this kind of a hybrid car, The thing equipped with the dc-battery which exchanges the 1st motor which outputs and inputs power to the sun gear of an epicyclic gear device, the 2nd motor which output and input power to a driving shaft, the 1st motor and the 2nd motor, and power is proposed (for example, patent reference 1 reference).
[0003]
[Patent reference 1]
JP,2000-197208,A (drawing 1)
[0004]
[Problem(s) to be Solved by the Invention]
In such a hybrid car, if regenerative control of the 2nd motor is carried out so that the driving force which processed by annealing to the demand driving force corresponding to this OFF actuation may be outputted to a driving shaft when an accelerator pedal is changed into OFF actuation from ON actuation, the shock of the torque to the driving shaft over modification to the OFF actuation from ON actuation of an accelerator pedal can be stopped. However, if it processes by annealing to the demand driving force corresponding to off actuation of an accelerator pedal, since a drive condition may be maintained temporarily, without being in a regeneration condition immediately, the 2nd motor can consider the case where it discharges exceeding a discharge limit of a dc-battery depending on the drive condition of the 1st motor.
[0005]
The hybrid car and its control approach of this invention aim at outputting smoothly the demand driving force corresponding to the accelerator-off after accelerator-on was carried out to a driving shaft, taking into consideration a discharge limit of accumulation-of-electricity equipments, such as a dc-battery.
[0006]
[The means for solving a technical problem, and its operation and effectiveness]
The hybrid car and its control approach of this invention took the following means, in order to attain the above-mentioned purpose.
[0007]
The hybrid car of this invention,
It is the hybrid car in which an output of power is possible to the driving shaft connected to the driving wheel,

With an internal combustion engine
A power power I/O means to transmit a part of power [at least] from said internal combustion engine to said driving shaft with I/O of power and power,
The motor which can output and input power to said driving shaft,
Said power power I/O means, and said motor and the accumulation-of-electricity means which can exchange power,
the accelerator after accelerator-on was carried out -- an operation point setting means to set up the operation point of said internal combustion engine for outputting the driving force according to the driving force this demanded based on the this demanded driving force and a discharge limit of said accumulation-of-electricity means when the driving force depended off is required of said driving shaft,
The control means which controls this internal combustion engine, said power power I/O means, and said motor so that the driving force corresponding to said demanded driving force is outputted to said driving shaft, while said internal combustion engine is operated on the set-up this operation point
Let preparation ****** be a summary.
[0008]
When the driving force by the accelerator-off after accelerator-on was carried out is required of a driving shaft in the hybrid car of this this invention, The operation point of the internal combustion engine for outputting the driving force according to the driving force demanded based on this driving force and discharge limit of an accumulation-of-electricity means that were demanded is set up. The operation control of a power power I/O means to output a part of power [at least] from an internal combustion engine and an internal combustion engine to a driving shaft so that the driving force corresponding to the driving force demanded while the internal combustion engine was operated on this set-up operation point may be outputted to a driving shaft, and the motor which output and input power to a driving shaft is carried out. Therefore, it also becomes possible to output smoothly the driving force corresponding to the driving force demanded taking into consideration a discharge limit of an accumulation-of-electricity means to a driving shaft. here -- "-- the accelerator after accelerator-on was carried out -- demand" means that negative driving force was required, after forward driving force is required of a driving shaft for the driving force depended off.
[0009]
In the hybrid car of such this invention, said operation point setting means shall be a means to set up the 1st rotational frequency calculated as said internal combustion engine's rotational frequency from the driving force obtained by processing by annealing to said demanded driving force, and a discharge limit of said accumulation-of-electricity means as a target rotational frequency in said internal combustion engine's operation point. If it carries out like this, the driving force corresponding to the driving force demanded while taking into consideration the discharge limit of an accumulation-of-electricity means can be more smoothly outputted to a driving shaft. In the hybrid car of this invention of this mode, said operation point setting means shall be a means to set up a small rotational frequency as a target rotational frequency in said internal combustion engine's operation point among the 2nd rotational frequency obtained by processing by annealing to said internal combustion engine's rotational frequency calculated from said demanded driving force, and said 1st rotational frequency. If it carries out like this, it can adjust taking into consideration a discharge limit of an accumulation-of-electricity means so that an internal combustion engine's rotational frequency may be changed smoothly.
[0010]
In the hybrid car of this invention of the mode which calculates this 1st engine speed an account operation point setting means The relation it is equal to the driving force with which the sum of the 1st driving force transmitted to said driving shaft based on the power outputted and inputted from said power power I/O means and the 2nd driving force which are outputted and inputted by this driving shaft from said motor processes by annealing to said demanded driving force, and is obtained unrelated, With said power power I/O means Said 1st rotational frequency by which the sum of the 1st power outputted and inputted and the 2nd power which are outputted and

inputted by said motor is calculated based on said 1st driving force called for from the relation it is equal to a discharge limit of said accumulation-of-electricity means unrelated as a target rotational frequency in said operation point It shall be a means to set up. If it carries out like this, since it is calculable as the rotational frequency calculated from the driving force obtained by processing by annealing to the driving force of which the 1st rotational frequency was required, or the rotational frequency of a discharge limit of an accumulation-of-electricity means within the limits, the operation control of the internal combustion engine can be carried out on the more suitable operation point. In the hybrid car of this invention of this mode said operation point setting means As opposed to the relational expression of the target power which should be outputted and inputted from this power power I/O means at the time of carrying out feedback control of said power power I/O means using the this set-up target rotational frequency when said internal combustion engine's target rotational frequency is set up It shall be a means to calculate said target rotational frequency obtained by inverse operation, using the power outputted and inputted from said power power I/O means calculated from said 1st driving force as said target power as said 1st rotational frequency.

[0011]

In the hybrid car of this invention of the mode which calculates the 1st engine speed moreover, said control means Drive control of said power power I/O means is carried out on the drive conditions set up in order to operate said internal combustion engine on said set-up operation point. It shall be the means which carries out drive control of said motor so that the driving force corresponding to difference with the driving force obtained by processing by annealing to the driving force which acts on said driving shaft by this drive control, and the driving force by said demanded accelerator-off may be outputted to this driving shaft. If it carries out like this, it can anneal to the demanded driving force and the driving force processed and obtained can be outputted to a driving shaft. In the hybrid car of this invention of this mode, said control means shall be a means which carries out drive control of said motor within the limits of a discharge limit of said accumulation-of-electricity means. If it carries out like this, the driving force which processed by annealing to the driving force demanded within the limits of the discharge limit of an accumulation-of-electricity means can be outputted to a driving shaft.

[0012]

In the hybrid car of this invention said power power I/O means A 3 shaft type power I/O means to output and input power on a residual shaft based on the power which connected with 3 of the output shaft, said driving shaft, and 3rd shaft of said internal combustion engine shafts, and was outputted and inputted on any 2 shafts of these three shafts, Shall equip said 3rd shaft with the generator which outputs and inputs power, and said power power I/O means It is accompanied by I/O of the power by operation. the 1st rotator attached in said internal combustion engine's output shaft, and the 2nd rotator attached in said driving shaft -- having -- the electromagnetism of this 1st rotator and this 2nd rotator -- a part of power [at least] from this internal combustion engine It shall be the pair-of-observations trochanter motor outputted to this driving shaft.

[0013]

The control approach of the hybrid car of this invention,

It is the control approach of a hybrid car equipped with an internal combustion engine, a power power I/O means to transmit a part of power [at least] from this internal combustion engine to the driving shaft connected to the driving wheel with I/O of power and power, the motor that can output and input power to this driving shaft, and this power power I/O means, and this motor and the accumulation-of-electricity means which can exchange power,

(a) said driving shaft -- an accelerator -- the operation point of said internal combustion engine for outputting the driving force according to the driving force this demanded based on the this demanded driving force and a discharge limit of said accumulation-of-electricity means, when the driving force depended off is required -- setting up

(b) While said internal combustion engine is operated on the set-up this operation point, control this internal combustion engine, said power power I/O means, and said motor so that the driving force corresponding to said demanded driving force is outputted to said driving shaft.

Let things be summaries.
[0014]
When the driving force by the accelerator-off after accelerator-on was carried out is required of a driving shaft according to the control approach of the hybrid car of this this invention, The operation point of the internal combustion engine for outputting the driving force according to the driving force demanded based on this driving force and discharge limit of an accumulation-of-electricity means that were demanded is set up. Since the operation control of a power power I/O means to output a part of power [at least] from an internal combustion engine and an internal combustion engine to a driving shaft, and the motor which output and input power to a driving shaft is carried out so that the driving force corresponding to the driving force demanded while the internal combustion engine was operated on this set-up operation point may be outputted to a driving shaft It also becomes possible to output smoothly the driving force corresponding to the driving force demanded taking into consideration a discharge limit of an accumulation-of-electricity means to a driving shaft. here -- "-- the accelerator after accelerator-on was carried out -- demand" means that negative driving force was required, after forward driving force is required of a driving shaft for the driving force depended off.
[0015]
[Embodiment of the Invention]
Next, the gestalt of operation of this invention is explained using an example. Drawing 1 is the block diagram showing the outline of the configuration of a hybrid car 20 in which the power output unit which is one example of this invention was carried. The hybrid car 20 of an example so that it may illustrate An engine 22, The power distribution integrated device 30 of 3 shaft type connected to the crankshaft 26 as an output shaft of an engine 22 through the damper 28, The reduction gear 35 attached in ring wheel shaft 32a as a driving shaft connected to the motor MG 1 which was connected to the power distribution integrated device 30, and which can be generated, and the power distribution integrated device 30, It has the motor MG 2 connected to this reduction gear 35, and the electronic control unit 70 for hybrids which controls the whole power output unit.
[0016]
An engine 22 is an internal combustion engine which outputs power with the fuel of hydrocarbon systems, such as a gasoline or gas oil, and has received operation controls, such as fuel-injection control, and ignition control, inhalation air-adjust control, from the various sensors which detect the operational status of an engine 22 with the electronic control unit 24 for engines (henceforth Engine ECU) which inputs a signal. The engine ECU 24 is communicating with the electronic control unit 70 for hybrids, and it outputs the data about the operational status of an engine 22 to the electronic control unit 70 for hybrids if needed while it carries out the operation control of the engine 22 with the control signal from the electronic control unit 70 for hybrids.
[0017]
The power distribution integrated device 30 is equipped with an external-tooth gearing's sun gear 31, this sun gear 31 and the ring wheel 32 of the internal gear arranged on a concentric circle, two or more pinion gears 33 that gear to a ring wheel 32 while gearing to a sun gear 31, and the carrier 34 which holds two or more pinion gears 33 free [rotation and revolution], and is constituted as an epicyclic gear device in which a differential operation is performed by using a sun gear 31, a ring wheel 32, and a carrier 34 as a rotation element. On a carrier 34, the power distribution integrated device 30 the crankshaft 26 of an engine 22 The reduction gear 35 is connected with the ring wheel 32 for the motor MG 1 through ring wheel shaft 32a at the sun gear 31, respectively. The power from the engine 22 inputted from a carrier 34 when a motor MG 1 functions as a generator is distributed to a sun gear 31 and ring wheel 32 side according to the gear ratio. When a motor MG 1 functions as a motor, the power from the motor MG 1 inputted from the power and the sun gear 31 from the engine 22 inputted from a carrier 34 is unified, and it outputs to a ring wheel 32 side. Finally the power outputted to the ring wheel 32 is outputted to the driving wheels 63a and 63b of a car through the gear device 60 and a differential gear 62 from ring wheel shaft 32a.

[0018]
A motor MG 1 and a motor MG 2 are constituted as a synchronous generator motor of the common knowledge which can be driven as a motor while each can drive them as a generator, and they perform an exchange of a dc-battery 50 and power through inverters 41 and 42. Power Rhine 54 which connects inverters 41 and 42 and a dc-battery 50 is constituted as the positive-electrode bus-bar which each inverters 41 and 42 share, and a negative-electrode bus-bar, and can consume now the power generated with either of the motors MG1 and MG2 by other motors. Therefore, the charge and discharge of the dc-battery 50 will be carried out by the power produced from either of the motors MG1 and MG2, or insufficient power. In addition, the charge and discharge of the thing which balances power income and outgo by motors MG1 and MG2, then the dc-battery 50 are not carried out. Drive control of the motors MG1 and MG2 is carried out by each with the electronic control unit 40 for motors (henceforth Motor ECU). The phase current impressed to the motors MG1 and MG2 detected by a signal required in order to carry out drive control of the motors MG1 and MG2, for example, the signal from the rotation location detection sensors 43 and 44 which detect the rotation location of the rotator of motors MG1 and MG2, and the current sensor which is not illustrated is inputted into the motor ECU 40, and the switching control signal to inverters 41 and 42 is outputted from the motor ECU 40. The motor ECU 40 is communicating with the electronic control unit 70 for hybrids, and it outputs the data about the operational status of motors MG1 and MG2 to the electronic control unit 70 for hybrids if needed while it carries out drive control of the motors MG1 and MG2 with the control signal from the electronic control unit 70 for hybrids.
[0019]
The dc-battery 50 is managed with the electronic control unit 52 for dc-batteries (henceforth Dc-battery ECU). A signal required to manage a dc-battery 50 to a dc-battery ECU 52, For example The electrical potential difference between terminals from the voltage sensor which was installed between the terminals of a dc-battery 50 and which is not illustrated, The cell temperature Tb from the temperature sensor 51 attached in the charge and discharge current from the current sensor which was attached in power Rhine 54 connected to the output terminal of a dc-battery 50, and which is not illustrated and the dc-battery 50 etc. is inputted. The data about the condition of a dc-battery 50 are outputted to the electronic control unit 70 for hybrids by communication link if needed. With this dc-battery ECU 52, in order to manage a dc-battery 50, remaining capacity (SOC) is calculated based on the addition value of the charge and discharge current detected by the current sensor.
[0020]
The electronic control unit 70 for hybrids is constituted as a microprocessor centering on CPU72, and is equipped with ROM74 which memorizes the processing program other than CPU72, RAM76 which memorizes data temporarily, and the input/output port and the communication link port which is not illustrated. The vehicle speed V from the brake-pedal position BP and speed sensor 88 from the brake-pedal position sensor 86 which detects the accelerator opening Acc from the accelerator pedal position sensor 84 which detects the shift position SP from the shift position sensor 82 which detects the actuated valve position of the ignition signal from an ignition switch 80 and a shift lever 81, and the amount of treading in of an accelerator pedal 83, and the amount of treading in of a brake pedal 85 etc. is inputted into the electronic control unit 70 for hybrids through input port. It connects with the engine ECU 24, the motor ECU 40, and the dc-battery ECU 52 through the communication link port, and the electronic control unit 70 for hybrids is performing the exchange of an engine ECU 24, a motor ECU 40, a dc-battery ECU 52, and various control signals and data, as mentioned above.
[0021]
In this way, the hybrid car 20 of the constituted example calculates the demand torque which should be outputted to ring wheel shaft 32a as a driving shaft based on the accelerator opening Acc and the vehicle speed V corresponding to the amount of treading in of an accelerator pedal 83 by the operator, and the operation control of an engine 22, a motor MG 1, and the motor MG 2 is carried out so that the demand power corresponding to this demand torque may be outputted to ring wheel shaft 32a. As an operation control of an engine 22, a motor MG 1, and a

motor MG 2 While carrying out the operation control of the engine 22 so that the power corresponding to demand power may be outputted from an engine 22 All the power outputted from an engine 22 by the power distribution integrated device 30, the motor MG 1, and the motor MG 2 So that torque conversion may be carried out and it may be outputted to ring wheel shaft 32a While carrying out the operation control of the engine 22 so that the power corresponding to the sum of the torque conversion operation mode and demand power which carry out drive control of a motor MG 1 and the motor MG 2, and power required for the charge and discharge of a dc-battery 50 may be outputted from an engine 22 So that demand power may be outputted to ring wheel shaft 32a with torque conversion according [all of the power outputted from an engine 22 with the charge and discharge of a dc-battery 50 or its part] to the power distribution integrated device 30, a motor MG 1, and a motor MG 2 There are charge-and-discharge operation mode which carries out drive control of a motor MG 1 and the motor MG 2, motor operation mode which carries out an operation control so that the power which suspends operation of an engine 22 and balances demand power from a motor MG 2 may be outputted to ring wheel shaft 32a.

[0022]

Next, while actuation of the hybrid car 20 of the example constituted in this way, especially an operator break in an accelerator pedal 83 and are making it run a hybrid car 20, the actuation when detaching an accelerator pedal 83 is explained. Drawing 2 is a flow chart which shows an example of the operation control routine performed with the electronic control unit 70 for hybrids of the hybrid car 20 of an example. This routine is repeatedly performed for every (every [for example,] 8msec) predetermined time from from, when the accelerator pedal 83 which the operator had broken in is detached. In addition, the judgment when detaching the broken-in accelerator pedal 83 can be performed based on the accelerator opening Acc of last time and this time.

[0023]

If an operation control routine is performed, CPU72 of the electronic control unit 70 for hybrids will first perform processing which inputs data required for control, such as 1 and Nm2, several Nm rotation of the vehicle speed V from the accelerator opening Acc and the speed sensor 88 from an accelerator pedal 83, the rotational frequency Ne of the crankshaft 26 of an engine 22, a motor MG 1, and a motor MG 2 (step S100). Here, 1 and Nm2 shall input by communication link what was calculated based on the rotation location of the rotator of the motors MG1 and MG2 detected by the rotation location detection sensors 43 and 44 from a motor ECU 40 several Nm rotation of motors MG1 and MG2. Moreover, the rotational frequency Ne of an engine 22 shall input what was calculated based on the rotational frequency Nr of ring wheel shaft 32a which breaks 2 by the gear ratio Gr (rotational frequency of the rotational frequency / ring wheel shaft 32a of a motor MG 2) of a reduction gear 35 motor's MG's 1 several Nm rotation 1 and several Nm rotation of a motor MG 2, and is obtained, and gear ratio rho (a sun gear number of teeth / ring wheel number of teeth) of the power distribution integrated device 30. Of course, a rotational frequency sensor is attached in the crankshaft 26 of an engine 22, and it is not cared about as a thing using that by which direct detection was carried out.

[0024]

Then, while setting up demand torque Tr* required of ring wheel shaft 32a as a driving shaft based on the accelerator opening Acc and the vehicle speed V, target power Pe* which an engine 22 should output is set up (step S102). In the example, it is memorized to ROM74, using a setup of demand torque Tr* as the map for demand set torques beforehand in quest of the relation between the accelerator opening Acc, and the vehicle speed V and demand torque Tr*, and if the accelerator opening Acc and the vehicle speed V are given, it shall draw and set up demand torque Tr* which corresponds from the map for demand set torques. An example of the map for demand set torques is shown in drawing 3 . A setup of target power Pe* of an engine 22 shall set up the thing adding charge-and-discharge amount-required Pb* of the dc-battery 50 set as what multiplied set-up demand torque Tr* by the engine speed Nr of ring wheel shaft 32a according to the remaining capacity SOC of a dc-battery 50, and a loss as target power Pe* of an engine 22 in the example.

[0025]
And it anneals using a degree type (1) to demand torque Tr* to set-up ring wheel shaft 32a, and processed and anneals, and demand torque Tr1* is calculated (step S104). Here, among the formula (1), "K1" is a constant, and in order to change smoothly the torque which acts on ring wheel shaft 32a, it is set up within the limits of the value 0 - the value 1. Moreover, "last Tr1*" was set up at step S104 of the last operation control routine, is annealed, and is demand torque.
[0026]
Tr1*= last time Tr1*+ (Tr*-last time Tr1*), K1 (1)
[0027]
it calculated, when it annealed and demand torque Tr1* was calculated -- it anneals and a motor MG 1 is temporary from a degree type (2) and a formula (3) using the discharge limit Wout of demand torque Tr1* or a dc-battery 50 -- motor torque Tm1tmp is calculated (step S106). It is the relation what added the loss to total of the power by which a formula (3) is outputted and inputted by the motor MG 1 and the motor MG 2 is a formula (2) is relation total of the torque outputted to ring wheel shaft 32a as a driving shaft by the motor MG 1 and the motor MG 2 anneals, and it is equal to demand torque Tr1* unrelated, and equal to the discharge limit Wout of a dc-battery 50 here unrelated. In addition, the discharge limit Wout of a dc-battery 50 can be calculated from temperature Tb, remaining capacity SOC, etc. of a dc-battery 50. The collinear Fig. for explaining dynamically the rotation element of the power distribution integrated device 30 to drawing 4 is shown. Two thick wire arrow heads, in drawing and R top, show the torque which torque Te* outputted from an engine 22 is delivered to ring wheel shaft 32a, and the torque to which the torque to which it is outputted from a motor MG 2 acts on ring wheel shaft 32a through a reduction gear 35, while operating the engine 22 steadily on the operation point of target torque Te* and target engine-speed Ne*. Therefore, it turns out that the left part of a formula (2) serves as torque of the sum with the torque transmitted to ring wheel shaft 32a from an engine 22 when torque Tm1tmp is outputted from the torque transmitted to ring wheel shaft 32a through a reduction gear 35 when torque Tm2tmp is outputted from a motor MG 2, and a motor MG 1.
[0028]
Tm2tmp-Gr-Tm1tmp/rho=Tr1* (2)
Nm2, Tm2 tmp+Nm1, and Tm1 tmp+Loss=Wout (3)
[0029]
and When target several Nm rotation 1* is set up The relational expression showing in the degree type (4) for searching for the torque (target torque Tm1*) which should output a motor MG 1 based on the deflection of 1 from the motor MG 1 in the feedback control for rotating a motor MG 1 by target several Nm rotation 1* target several Nm rotation 1* and several Nm current rotation temporary [replace with target torque Tm1* and] -- counting backward using motor torque Tm1tmp -- several temporary motor rotations -- Nm1tmp is calculated (step S108). temporary -- motor torque Tm1tmp and several temporary motor rotations -- the relational expression using Nm1tmp is shown as a formula (5). Here, the function PID in a formula (4) and a formula (5) is constituted by the proportional, integral term, or differential term in feedback control. Moreover, "last Tm1*" is the target torque of the motor MG 1 set up at step S118 later mentioned by the last operation control routine.
[0030]
Tm1*= last time Tm1*+PID (Nm1, Nm1*) (4)
Tm1tmp= last time Tm1*+PID (Nm1, Nm1tmp) (5)
[0031]
in this way, several temporary motor rotations -- several temporary motor rotations calculated when Nm1tmp was calculated -- the temporary engine speed Netmp1 is calculated by the degree type (6) using gear ratio rho of Nm1tmp, the rotational frequency Nr (Nm2/Gr) of current ring wheel shaft 32a, and the power distribution integrated device 30 (step S110). Processing of such steps S104-S110 can be called processing which calculates the temporary engine speed Netmp1 as an engine speed of the engine 22 which reconciles the limit (it anneals to demand torque Tr1* in step S104, and processing is considerable) for changing smoothly the torque

made to act on ring wheel shaft 32a as a driving shaft to demand torque Tr*, and the discharge limit Wout of a dc-battery 50.

[0032]

Netmp1=Nm1tmp-rho/(1+rho) +(Nm2/Gr)/(1+rho) (6)

[0033]

Next The engine speed in the operation point which can operate an engine 22 efficiently among the operation points (point which becomes settled from torque and an engine speed) of the engine 22 in which an output of target power Pe* of the engine 22 set up at step S102 is possible is made into the temporary engine speed Netmp2. It sets up (step S112), anneals using a degree type (7) to the set-up temporary engine speed Netmp2, and processed and anneals, and an engine speed Netmp3 is calculated (step S114). Among the formula (7), "K2" is a constant, and it is set up in the range of a value 0 - a value 1 in order to change the rotational frequency of an engine 22 smoothly. Moreover, "last Ne*" is target rotational frequency Ne* of the engine 22 set up at step S116 later mentioned in the last operation control routine.

[0034]

Nmtmp3= last time Ne*+ (Netmp2-last time Ne*), K2 (7)

[0035]

And target torque Te* of an engine 22 is calculated by breaking by target engine-speed Ne* which set up demand power Pe* which was calculated at the temporary engine speed Netmp1 calculated at step S110, and step S114, and which was set up at step S102 while annealing and setting up the engine speed of the smaller one as target engine-speed Ne* of an engine 22 among engine speeds Netmp3 (step S116). It anneals with the temporary engine speed Netmp1. An engine speed Netmp3 The rotational frequency for being compatible in the discharge limit Wout of the smooth modification of torque and the dc-battery 50 which are made to act on ring wheel shaft 32a to demand torque Tr*, respectively, as mentioned above, Since it is equivalent to the rotational frequency for changing the rotational frequency of an engine 22 smoothly The engine speed of an engine 22 can be changed comparatively smoothly, making smooth a change of the torque which acts to a driving shaft within the limits of the discharge limit Wout of a dc-battery 50 by setting up the engine speed of the smaller one of them as target engine-speed Ne* of an engine 22.

[0036]

If target rotational frequency Ne* of an engine 22 is set up While calculating target several Nm rotation 1* of a motor MG 1 by the degree type (8) using target rotational frequency Ne* of an engine 22 and the rotational frequency Nr (Nm2/Gr) of ring wheel shaft 32a which were set up, and gear ratio rho of the power distribution integrated device 30 Target torque Tm1* of a motor MG 1 is calculated by the above-mentioned formula (4) using calculated target several Nm rotation 1* (step S118).

[0037]

Nm1*=Ne*-(1+rho)/rho-(Nm2/Gr)/rho (8)

[0038]

Then, the discharge limit Wout of a dc-battery 50 By dividing deflection with the power consumption (generated output) of the motor MG 1 which multiplies target torque Tm1* of the calculated motor MG 1 by 1 several Nm rotation of the current motor MG 1, and is obtained by 2 several Nm rotation of a motor MG 2 While calculating torque limitation Tmax as an upper limit of the torque which may be outputted from a motor MG 2 by the degree type (9) (step S120) As torque which processed at step S104 by annealing to demand torque Tr* to ring wheel shaft 32a and which should be annealed and should be outputted from a motor MG 2 using demand torque Tr1*, target torque Tm1* of a motor MG 1, gear ratio rho of the power distribution integrated device 30, and the gear ratio Gr of a reduction gear 35 **** motor torque Tm2tmp is calculated by the degree type (10) (step S122), and as temporary as calculated torque limitation Tmax -- motor torque Tm2tmp is compared and the torque of the smaller one is set up as target torque Tm2* of a motor MG 2 (step S124). It can set up as torque which restricted torque required since [which can change smoothly by this demand torque Tr* as which an operator demands target torque Tm2* of a motor MG 2] it anneals and demand torque Tr1* is outputted to ring

wheel shaft 32a within the limits of the discharge limit Wout of a dc-battery 50.
[0039]
Tmax= (Wout-Tm1*, Nm1)/Nm2 (9)
Tm2tmp= (Tr1*+Tm1*/rho)/Gr (10)
[0040]
In this way, if target rotational frequency Ne* of an engine 22 and target torque Te*, target rotation severalNm1* of a motor MG 1 and target torque Tm1*, and target torque Tm2* of a motor MG 2 are set up About target engine-speed Ne* of an engine 22, and target torque Te*, in an engine ECU 24 About target rotation severalNm1* of a motor MG 1 and target torque Tm1*, and target torque Tm2* of a motor MG 2, it outputs to a motor ECU 40 (step S126), and this routine is ended. Thereby, the engine ECU 24 which received target engine-speed Ne* and target torque Te* controls fuel-injection control, ignition control, etc. in an engine 22 so that an engine 22 is operated by target engine-speed Ne* and target torque Te*. Moreover, the motor ECU 40 which received target rotation severalNm1* and target torque Tm1*, and target torque Tm2* performs switching control of the switching element of inverters 41 and 42 so that a motor MG 2 may be operated by target torque Tm2*, while a motor MG 1 is operated by target torque Tm1*.
[0041]
When according to the hybrid car 20 of an example explained above the accelerator pedal 83 into which it got is detached and demand torque Tr* is changed into negative from forward The engine speed for reconciling the discharge limit Wout of the smooth modification of torque and the dc-battery 50 which are made to act on ring wheel shaft 32a to this demand torque Tr* (temporary engine speed Netmp1), Since the engine speed of the smaller one is set up as target engine-speed Ne* of an engine 22 among the engine speeds (temporary engine speed Netmp3) for changing the engine speed Ne of an engine 22 smoothly and an engine 22 and motors MG1 and MG2 are controlled The rotational frequency of an engine 22 can be changed comparatively smoothly, changing smoothly the torque which acts to ring wheel shaft 32a within the limits of the discharge limit Wout of a dc-battery 50 to the actuation which detaches the accelerator pedal 83 into which the operator got.
[0042]
Although it shall anneal with the temporary engine speed Netmp1, the engine speed of the smaller one shall be set up as target engine-speed Ne* of an engine 22 among engine speeds Netmp3 and an engine 22 and motors MG1 and MG2 shall be controlled by the hybrid car 20 of an example When off actuation of the accelerator pedal 83 is done by the operator from ON actuation Also in the correspondence to demand torque Tr*, importance rather than smooth modification of the rotational frequency Ne of an engine 22 It is good also as what sets up the engine speed for reconciling the discharge limit Wout of the smooth modification of torque and the dc-battery 50 which are made to act on ring wheel shaft 32a to demand torque Tr* as target engine-speed Ne* of an engine 22, and controls an engine 22 and motors MG1 and MG2.
[0043]
temporary to the relational expression of the feedback control according to PID control at the process which calculates the temporary engine speed Netmp1 in the hybrid car 20 of an example -- counting backward using motor torque Tm1tmp -- several temporary motor rotations -- although Nm1tmp shall be calculated, feedback control is good also as feedback control by the PI control which is not limited to PID control and does not have a differential term, and good also as feedback control by the proportional control which does not have an integral term further.
[0044]
Although it shall change gears by the reduction gear 35 and the power of a motor MG 2 shall be outputted to ring wheel shaft 32a in the hybrid car 20 of an example So that it may illustrate to the hybrid car 120 of the modification of drawing 5 It is good also as what connects the power of a motor MG 2 to the axle (axle connected to the wheels 64a and 64b in drawing 5) with which ring wheel shaft 32a differs from the connected axle (axle to which driving wheels 63a and 63b were connected).
[0045]

Although the power of an engine 22 shall be outputted to ring wheel shaft 32a as a driving shaft connected to driving wheels 63a and 63b through the power distribution integrated device 30 in the hybrid car 20 of an example It has the outer rotor 234 connected to the driving shaft which outputs power to the inner rotor 232 connected to the crankshaft 26 of an engine 22, and driving wheels 63a and 63b so that it may illustrate to the hybrid car 220 of the modification of drawing 6 . While transmitting a part of power of an engine 22 to a driving shaft, it is good also as a thing equipped with the motor 230 for Rota which changes residual power into power.

[0046]

As mentioned above, although the gestalt of operation of this invention was explained using the example, as for this invention, it is needless to say that it can carry out with the gestalt which becomes various within limits which are not limited to such an example at all and do not deviate from the summary of this invention.

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the outline of the configuration of the hybrid car 20 of one example of this invention.

[Drawing 2] It is the flow chart which shows an example of the operation control routine performed with the electronic control unit 70 for hybrids of the hybrid car 20 of an example.

[Drawing 3] It is the map in which the relation between the accelerator opening Acc, and the vehicle speed V and demand torque Tr* is shown.

[Drawing 4] It is a collinear Fig. for explaining dynamically the rotation element of the power distribution integrated device 30.

[Drawing 5] It is the block diagram showing the outline of the configuration of the hybrid car 120 of a modification.

[Drawing 6] It is the block diagram showing the outline of the configuration of the hybrid car 220 of a modification.

[Description of Notations]

20,120,220 A hybrid car, 22 Engine, 24 The electronic control unit for engines (engine ECU), 26 Crankshaft, 28 A damper, 30 A power distribution integrated device, 31 A sun gear, 32 Ring wheel, 32a A ring wheel shaft, 33 A pinion gear, 34 Carrier, 35,135 A reduction gear, 40 The electronic control unit for motors (motor ECU), 41 42 43 An inverter, 44 A rotation location detection sensor, 50 Dc-battery, 51 A temperature sensor, the electronic control unit for 52 dc-batteries (dc-battery ECU), 54 Power Rhine, 60 A gear device, 62 Differential gear, 63a, 63b, 64a, 64b A driving wheel, 70 The electronic control unit for hybrids, 72 CPU, 74 ROM, 76 RAM, 80 Ignition switch, 81 A shift lever, 82 A shift position sensor, 83 Accelerator pedal, 84 An accelerator pedal position sensor, 85 A brake pedal, 86 A brake-pedal position sensor, 88 A speed sensor, 230 A pair Rota motor, 232 Inner rotor 234 An outer rotor, MG1, MG2 Motor.

[Translation done.]

* NOTICES *

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damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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